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Does malaria control impact education? Evidence from Roll Back Malaria in Africa

Maria Kuecken, Josselin Thuilliez and Marie-Anne Valfort

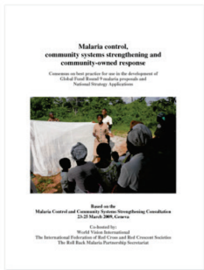
PARIS SCHOOL OF ECONOMICS
ÉCOLE D'ÉCONOMIE DE PARIS

Relying on microeconomic data, we examine the impact of the Roll Back Malaria (RBM) control campaigns on the educational attainment of primary school children in 14 Sub-Saharan African countries. Combining a difference-in-differences approach with an IV analysis, we exploit exogenous variation in pre-campaign malaria prevalence and exogenous variation in exposure to the timing and disbursements of the RBM campaign. In all 14 countries, the RBM campaign reveals itself as a particularly cost-effective strategy to improve primary school children's educational attainment.

MORE VALUE FOR THE MONEY TO PAVE THE WAY TOWARD MALARIA ERADICATION

In 1998, the World Health Organization (WHO) launched a new campaign aiming to halve malaria deaths worldwide by 2010 (Nabarro and Taylor (1998)) – a target which has very recently been achieved. With this goal came the need to establish **a global framework for coordinated action against malaria**, and **the Roll Back Malaria (RBM)** Partnership was born.

Throughout the 2000s, many initiatives arose in support of the RBM Partnership. Following its formation in 2002, the Global Fund to Fight AIDS, Tuberculosis, and Malaria became the largest source of external funding for malaria control programs. The Global Fund has expanded its commitments to malaria control efforts from $68 million disbursed the year of its inception to over $1 billion per year by the late 2000s (see Pigott et al. (2012)). The PMI-President's Malaria Initiative (launched in 2005 by President George W. Bush) and the World Bank Booster Program for Malaria Control in Africa entered the fight a few years later, **each program contributing significant funds in support of malaria control**. Sponsored control efforts focus on the treatment of clinical cases as well as on prevention among populations who are the most at-risk through artemisinin combination therapies (ACTs). They also seek to limit the transmission of malaria from mosquitoes to humans with insecticide treated nets (ITNs) and indoor residual spraying (IRS).



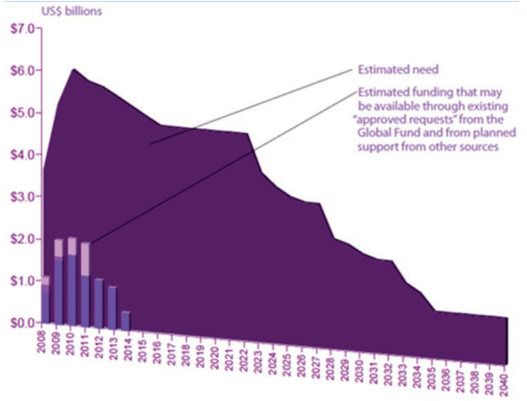
An exemple of a document available in the RBM toolbox

Children under the age of five and pregnant women are the primary targets of most malaria control programs. These populations experience the most acute symptoms of malaria and highest risks of death. RBM-sponsored interventions have allowed for a substantial decrease in infant mortality (see, for example, Bhattarai et al. (2007)). However, malaria does not only kill. Malaria-related morbidity is also known to impede human capital accumulation, by contributing to school absenteeism and damaging children's ability to concentrate and learn (Thuilliez et al. (2010)).

Therefore, the benefits of the RBM malaria control campaigns may not be confined only to mortality and morbidity. **They may also have large spillovers on the educational attainment of primary school children**. Quantifying such spillovers is key to understanding the full impact of malaria control campaigns.

As shown in *Figure 1*, funding for malaria control continues to fall short of the amount needed to sustain control and progress toward global malaria elimination. In this context, studying whether every dollar disbursed generates "more value for the money" (CGD (2013)) is critical.

Figure 1 : Estimated need and estimated funding for current global malaria commitments from Global Fund, World Bank and US-PMI



Source: RBM, Global Fund, World Bank and US-PMI
http://www.rbm.who.int/ProgressImpactSeries/report1.html

A QUASI-EXPERIMENTAL APPROACH OF UNPRECEDENTED COVERAGE

Table 1 : Change in bednet and chloroquine usage in areas of low vs. high initial malaria prevalence

Country	Bednet Use Increase		Chloroquine Decrease	
	Low (2000)	High (2000)	Low (2000)	High (2000)
Burkina Faso	20.02%	46.14%	-44.37%	-48.60%
Cameroon	4.77%	3.98%	-22.11%	-26.59%
Ethiopia*	4.44%	15.18%	-0.77%	2.14%
Ghana	22.09%	30.89%	-41.77%	-33.26%
Guinea	16.87%	28.42%	-20.84%	-29.09%
Kenya	29.47%	48.03%	-2.25%	-2.94%
Malawi	29.03%	25.24%	NA	NA
Mali	16.90%	40.61%	-41.54%	-38.20%
Namibia*	7.54%	19.87%	NA	NA
Nigeria	15.00%	18.73%	-5.23%	-5.88%
Rwanda	54.14%	61.09%	NA	NA
Senegal	28.81%	36.45%	NA	NA
Uganda	44.94%	48.01%	-13.80%	-19.08%
Zimbabwe	6.06%	11.40%	-14.17%	-33.65%
	Mean diff-in-diff= +15.82%***		Mean diff-in-diff= -8.44%***	

Note: Bednet use is a dummy variable for having a mosquito net that was slept under the night before the interview. It is equal to 0 when this net was not used or when the household has no net.
* For Ethiopia and Namibia, bednet use has been replaced by bednet ownership because the data on bednet use was not available.
*** Refers to statistical significance at the 99% confidence level.

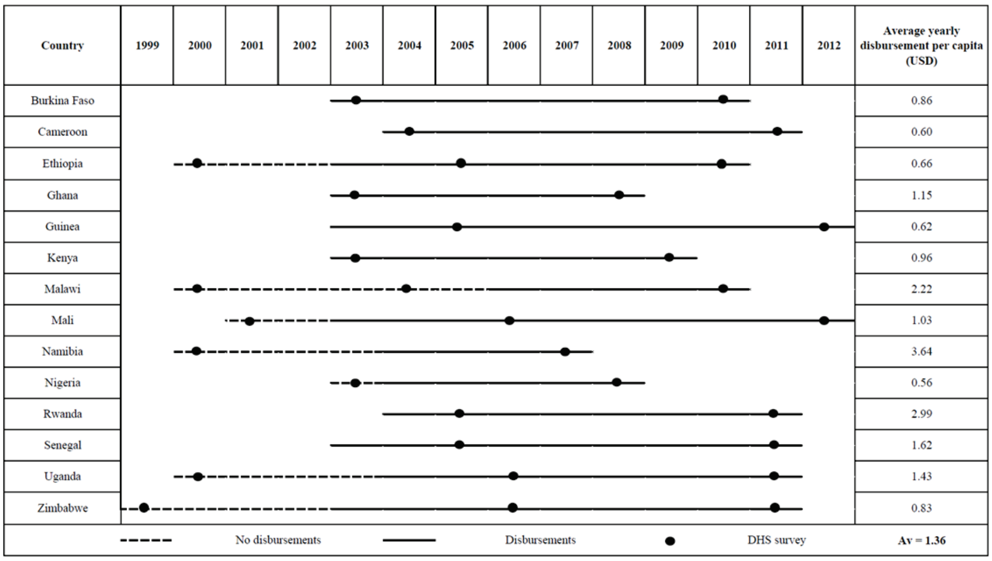
The few studies which have analyzed the impact of malaria eradication on educational outcomes find globally positive results (for example, Bleakley (2010), Lucas (2010)). However, these studies do not focus on the African continent, widely considered the malaria core. Studies that do focus on this area are well-targeted randomized control trials (Clarke et al. (2008)) with limited ability to address general equilibrium effects and restricted external validity. In Kuecken, Thuilliez and Valfort (2014) we seek to fill this gap.

We analyze the impact of the current RBM malaria control campaign on the educational outcomes of primary school students (N=389,233) in **14 countries of the African continent.** Starting from the early 2000s, we focus on the three largest external funders supporting the RBM campaign: the Global Fund to Fight AIDS, Tuberculosis and Malaria, the President's Malaria Initiative, and the World Bank Booster Program for Malaria Control in Africa.

Our approach exploits variation in pre-campaign malaria prevalence at the Demographic and Health Survey (DHS) cluster level and variation in children's exposure to the timing and disbursements of the RBM campaign. Following previous papers that have analyzed the impact of mid-twentieth century malaria eradication campaigns, we assume that DHS clusters with higher pre-campaign malaria prevalence should benefit relatively more from anti-malaria campaigns than DHS clusters with lower pre-campaign malaria prevalence. Given that the RBM initiative aims to curb malaria in Africa (not eliminate it explicitly), DHS clusters with higher pre-campaign malaria prevalence are more likely to belong to the treatment group than DHS clusters with lower pre-campaign malaria prevalence. And indeed, *Table 1* shows that the increase in bednet use between the pre-campaign period (or the time when the campaign was launched) and the post-campaign period is greater **by 15.82 percentage points** on average in clusters with relatively higher malaria prevalence. Similarly, the decrease in chloroquine use (due to the replacement of chloroquine by ACTs) is greater **by 8.44 percentage points** on average in clusters with higher pre-campaign malaria prevalence.

Moreover, we capture exposure to the treatment by the yearly amount per capita (at the country level) that the RBM has disbursed during a child's lifetime. As shown in *Figure 2*, the 14 countries in our sample are those which, as of January 2014, allow us to collect information on both unexposed and exposed children: these countries include at least one pre-campaign DHS round (or a round conducted close to the campaign's start date) and at least one DHS round conducted after the campaign's start date.

Figure 2 : DHS survey rounds, RBM campaign's start date and average yearly per capita disbursements during the period covered by Kuecken, Thuilliez and Valfort (2014)



Variation in exposure of children in a given country depends on the variation in DHS rounds and on the variation in children's date of birth, both of which are orthogonal to the timing and disbursements of the RBM campaign. However, pre-campaign malaria prevalence at the DHS cluster level is likely endogenous. We therefore instrument pre-campaign malaria prevalence with six different sets of instrumental variables, exploiting geographic, climatic and genetic data.

THE SPILLOVER EFFECTS OF MALARIA CONTROL ON EDUCATION

Our results reveal that, in all 14 countries, **the RBM malaria control campaigns positively affect the number of years of schooling completed and the grade level** during the current school year of primary school children.

The average child in our dataset is 10.5 years old with little variation from one country to another. *Table 2* reports, for each country, the impact of increasing the average yearly per capita RBM disbursements each year of this child's lifetime by one standard deviation, that is, by 0.33 USD on average. **The orders of magnitude are substantial**. This one-standard deviation increase translates into a mean increase of 1.12 standard deviations for grade level (a similar impact is found for the number of years of schooling). Put differently, one more dollar per capita disbursed each year of the average child's lifetime yields, on average, a yearly increase in grade by roughly 0.8.

Table 2 : Quantifying the impact of the RBM malaria control campaigns in Africa on grade

Country	Order of magnitude (impact of 1 standard deviation (0.33 USD) increase in the average yearly per capita RBM disbursements each year of the average child's lifetime)	Cost effectiveness (impact of 1 additional USD disbursed each year of the average child's lifetime)
Burkina Faso	3.296	1.942
Cameroon	1.289	0.725
Ethiopia	0.718	0.529
Ghana	1.591	1.424
Guinea	1.265	0.651
Kenya	0.378	0.313
Malawi	0.091	0.036
Mali	1.728	0.562
Namibia	1.255	0.922
Nigeria	1.281	3.441
Rwanda	0.208	0.035
Senegal	1.619	0.397
Uganda	0.556	0.230
Zimbabwe	0.404	0.316
Mean	**1.120**	**0.823**

To standardize, orders of magnitude are produced on the basis of disbursements per capita constructed over all age groups in a given country. Doing so yields a higher level of expenditure than that which would result from relying exclusively on disbursements to primary school students, pregnant women or children under 5 years old that are targeted by the campaign. Detailed results are provided in Kuecken, Thuilliez and Valfort (2014)

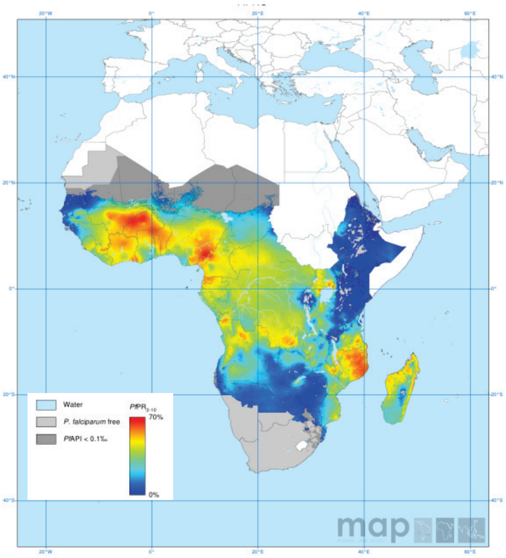
Among the 18 educational interventions whose impact on educational attainment is reviewed by Kremer and Holla (2009), only one, daily radio mathematics classes, has a greater effect that the one we compute for the RBM malaria control program. The increase in educational attainment caused by the other interventions never exceeds 0.5 standard deviations.

Obviously, we should expect the impact of the RBM anti-malaria campaign to be greater in countries with more room for improvement in educational attainment due to this campaign. And indeed, our orders of magnitude are **strongly correlated** (statistically significantly so) **with pre-campaign malaria prevalence** (positive relationship) and **with the gross enrolment rate in first grade** (negative relationship). These orders of magnitude also positively depend on the difference in increase in bednet use between high and low pre-campaign malaria prevalence clusters. Put differently, the stronger the empirical support for our identification assumption, according to which clusters with higher pre-campaign malaria prevalence should benefit relatively more from the campaign, the greater the impact of the campaign.

It is important to stress that these results are not driven by a mean-reversion effect whereby educational outcomes in DHS clusters in the treatment group converge to those of DHS clusters in the control group before the campaign. Nor are they biased by individuals' migration from a specific type of cluster to another. Our results are furthermore robust to alternative measures of malaria prevalence as well as to controlling for concomitant interventions with the RBM campaign.

Relying on a microeconomic analysis of unprecedented coverage, **we improve upon the literature** by measuring the spillovers of the RBM anti-malaria control campaigns in Africa on primary school educational attainments. We show that school-age children, who represent 26% of the population in Africa (United Nations (2013)), strongly benefit from the RBM campaigns. **Our finding points to the necessity of evaluating and investing in large-scale health interventions not only based on their health effects**. These interventions are indeed likely to help break inter-generational health-based poverty traps in which poor health during early childhood generates poor school participation and performance, lower labor participation and earnings, and increased reliance on health care (Berthélemy and Thuilliez (2014)). Focusing on the non-health outcomes of these interventions is all the more urgent given the difficulty of estimating the health impacts of programs whose medium-term aim is not elimination of health challenges but simply the reduction of their burden. In this context, one could assess the success of such programs through education instead of health, educational improvements being used as a marker of improved health outcomes. Finally, in a context where development priorities concerning education shift from enrollment to learning, our research contributes to the literature that aims to identify, among the many potential barriers faced by students in developing countries, those which impede the learning process (see, for instance, Glewwe et al. (2011) and Kuecken and Valfort (2013)).

The spatial distribution of Plasmodium falciparum malaria endemicity map in 2010 (from Malaria Atlas Project)



Mean point estimates of the age-standardised annual mean *Plasmodium falciparum* parasite rate in two to ten year olds (*Pf*PR$_{2-10}$) within the spatial limits of stable transmission. Areas of no risk and unstable risk (*Pf*API < 0.1‰) are also shown.

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